LISTING OF CLAIMS

1. (Cancelled)

2. (Withdrawn) The method according to claim 71, wherein a frequency of 1.3 times the first series resonant frequency f_0 is larger than a power frequency f_e.

3. (Withdrawn) The method according to claim 2, wherein the first series resonant frequency f_0 is larger than three times the power frequency f_e.

4. (Withdrawn) The method according to claim 3, wherein a series resonant frequency f_0' which is defined by a capacitance between the plasma excitation electrode and a counter electrode for generating the plasma in cooperation with the plasma excitation electrode, is larger than three times the power frequency f_e.

5. (Withdrawn) The method according to claim 4, wherein the plasma excitation electrode and the counter electrode are of a parallel plate type, and the series resonant frequency f_0' and the power frequency f_e satisfy the relationship:

wherein d represents the distance between the plasma excitation electrode and the counter electrode, and δ represents the sum of the distance between the plasma excitation electrode and the generated plasma and the distance between the counter

$$f_0' > \sqrt{\frac{d}{\delta}}\, f_e$$

electrode and the generated plasma.

6. (Withdrawn) The method according to claim 71, further comprising a resonant frequency measuring terminal for measuring a resonant frequency of the plasma processing chamber, in the vicinity of the end of the radio frequency feeder.

7. (Withdrawn) The method according to claim 6, further comprising a switch provided between the radio frequency feeder and the resonant frequency measuring terminal, wherein the switch electrically disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal and connects the end of the radio frequency feeder to the output end of the matching circuit in a plasma

excitation mode in which the plasma is excited, whereas the switch electrically connects the end of the radio frequency feeder to the resonant frequency measuring terminal and disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal in a measuring mode in which the resonant frequency of the plasma processing chamber is measured.

8. (Withdrawn) The method according to claim 6, further comprising a resonant frequency measuring unit which is detachably connected to the resonant frequency measuring terminal.

9 – 63. (Cancelled)

64. (Withdrawn) The method according to claim 72, wherein the plasma excitation electrode comprises an overlapping area with respect to the chamber wall, the overlapping area adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

65. (Withdrawn) The method according to claim 72, wherein the radio frequency feeder has a length adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

66. (Cancelled)

67. (Withdrawn) The method according to claim 73, wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the chamber wall, or the capacitance between a susceptor electrode and the chamber wall is adjusted such that 1.3 times the first series resonant frequency f_0 is larger than a power frequency f_e.

68. (Withdrawn) The method according to claim 73, wherein at least one of the shape of a feed plate, the overlapping area of the plasma excitation electrode and a chamber wall, insulation material between the plasma excitation electrode and the

chamber wall, or the capacitance between a susceptor electrode and the chamber wall is adjusted such that the first series resonant frequency f_0 is larger than a power frequency f_e.

69 – 70 (Cancelled)

71. (Withdrawn) A method of optimizing a plasma processing apparatus, the method comprising:

a) providing a plasma processing chamber having a plasma excitation electrode for exciting a plasma;

b) coupling a radio frequency generator to the plasma excitation electrode with a radio frequency feeder;

1) measuring an impedance path from the radio frequency feeder to ground via a shaft using a variable oscillation frequency during a non-discharge period;

2) calculating a first series resonant frequency f_0 based on the measured impedance path during the non-discharge period, the first series resonant frequency f_0 corresponding to a minimum impedance of the plasma processing chamber;

3) adjusting one or more mechanical parameters of the plasma processing chamber during the non-discharge period to modify the first series resonant frequency f_0 so that the first series resonant frequency f_0 measured at an end of the radio frequency feeder is larger than one-third of a power frequency f_e measured at the end of the radio frequency feeder; and

c) coupling a matching circuit between the radio frequency generator and the radio frequency feeder to match an impedance between the plasma processing chamber and the radio frequency generator.

72. (Withdrawn) A method of optimizing a plasma processing apparatus, the method comprising:

a) providing a plasma processing chamber, a counter electrode, and a shower plate, the plasma processing chamber having a plasma excitation electrode for exciting a plasma;

b) coupling a radio frequency generator to the plasma excitation electrode with a radiofrequency feeder; and

1) measuring an impedance path from the radio frequency feeder to ground via a shaft using a variable oscillation frequency during a non-discharge period;

2) calculating a first series resonant frequency f_0 based on the measured impedance path during the non-discharge period, the first series resonant frequency f_0 corresponding to a minimum impedance of the plasma processing chamber;

3) adjusting one or more mechanical parameters of the plasma processing chamber during the non-discharge period such that the first series resonant frequency f_0 measured at an end of the radio frequency feeder is larger than one-third of a power frequency f_e measured at the end of the radio frequency feeder;

c) coupling a matching circuit between the radio frequency generator and the radio frequency feeder to match an impedance between the plasma processing chamber and the radio frequency generator.

73. (Withdrawn) A method of optimizing a plasma processing apparatus, the method comprising:

a) providing a plasma processing chamber having a first series resonant frequency f_0 and a plasma excitation electrode for exciting a plasma;

b) coupling a radio frequency generator to the plasma excitation electrode with a radiofrequency feeder; and

1) measuring an impedance path from the radio frequency feeder to ground via a shaft using a variable oscillation frequency during a non-discharge period;

2) calculating the first series resonant frequency f_0 based on the measured impedance path during the non-discharge period, the first series resonant

frequency f_0 corresponding to a minimum impedance of the plasma processing chamber;

3) adjusting one or more of a shape of a feed plate, an overlapping area of the plasma excitation electrode and a chamber wall, and the capacitance between a susceptor electrode and a chamber wall such that the first series resonant frequency f_0 measured at an end of the radio frequency feeder is larger than one-third of a power frequency f_e measured at the end of the radio frequency feeder;

c) coupling a matching circuit between the radio frequency generator and the radio frequency feeder to match an impedance between the plasma processing chamber and the radio frequency generator.

74. (Currently amended) A plasma processing apparatus comprising:

a plasma processing chamber having a plasma excitation electrode for exciting a plasma;

a radio frequency generator for supplying a radio frequency voltage to the electrode;

a radio frequency feeder connected to the electrode;

a matching circuit having an input terminal and an output end, wherein the input terminal is connected to the radio frequency generator and the output end is connected to an end of the radio frequency feeder so as to achieve impedance matching between the plasma processing chamber and the radio frequency generator; and

a set of electrical radio frequency factors of the plasma processing chamber configured such that ~~at an end of the radio frequency feeder a frequency, which is~~ three times a first series resonant frequency f_0 of the plasma processing chamber~~,~~ is larger than a power frequency f_e of the radio frequency ~~waves at the end of the radio frequency feeder~~voltage,

wherein the first series resonant frequency f_0 ~~is based on the measured impedance of the path from the radio frequency feeder to the ground via a~~

~~shaft and a variable oscillation frequency when the plasma processing chamber is disconnected from the matching circuit , and the first series resonant frequency f_0~~ corresponds to a minimum impedance of the plasma processing chamber ~~when the plasma chamber is disconnected from the plasma apparatus during a non-discharge period~~.

75. (Currently amended) ~~A~~ The plasma processing apparatus according to claim 74, wherein a frequency of 1.3 times the first series resonant frequency f_0 is larger than ~~a~~ the power frequency f_e.

76. (Currently amended) ~~A~~The plasma processing apparatus according to claim 75, wherein the first series resonant frequency f_0 is larger than three times the power frequency f_e.

77. (Currently amended) ~~A~~ The plasma processing apparatus according to claim 76, wherein a series resonant frequency f_0' which is defined by a capacitance between the plasma excitation electrode and a counter electrode for generating the plasma in cooperation with the plasma excitation electrode, is larger than three times the power frequency f_e.

78. (Currently amended) ~~A~~ The plasma processing apparatus according to claim 77, wherein the plasma excitation electrode and the counter electrode are of a parallel plate type, and the series resonant frequency f_0' and the power frequency f_e satisfy the relationship:

$$f_0' > \sqrt{\frac{d}{\delta}}\ f_e$$

wherein d represents ~~the~~ a distance between the plasma excitation electrode and the counter electrode, and δ represents ~~the~~ a sum of ~~the~~ a distance between the plasma excitation electrode and ~~the~~ a generated plasma and ~~the~~ a distance between the counter electrode and ~~the~~ a generated plasma.

79. (Currently amended) ~~A~~ The plasma processing apparatus according to claim 74, further comprising a resonant frequency measuring terminal for measuring a resonant frequency of the plasma processing chamber[[,]] in the vicinity of the end of the radio frequency feeder.

80. (Currently amended) ~~A~~ The plasma processing apparatus according to claim 79, further comprising a switch provided between the radio frequency feeder and the resonant frequency measuring terminal, wherein the switch electrically disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal and connects the end of the radio frequency feeder to the output end of the matching circuit in a plasma excitation mode in which the plasma is excited, whereas the switch electrically connects the end of the radio frequency feeder to the resonant frequency measuring terminal and disconnects the end of the radio frequency feeder from the resonant frequency measuring terminal in a measuring mode in which the resonant frequency of the plasma processing chamber is measured.

81. (Currently amended) ~~A~~ The plasma processing apparatus according to claim 79, further comprising a resonant frequency measuring unit which is detachably connected to the resonant frequency measuring terminal.

82. (Cancelled)

83. (Currently amended) The plasma processing apparatus according to claim ~~82~~74, wherein the plasma excitation electrode comprises an overlapping area with respect to the chamber wall, the overlapping area adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than ~~a~~ the power frequency f_e ~~supplied from the radio frequency generator~~.

84. (Currently amended) The plasma processing apparatus according to claim ~~82~~74, wherein the radio frequency feeder has a length adapted to set the

first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than ~~a~~ the power frequency f_e ~~supplied from the radio frequency generator~~.

85. (Currently amended) A plasma processing apparatus comprising:

a plasma processing chamber having a plasma excitation electrode for exciting a plasma and a first series resonant frequency f_0 ~~and a plasma excitation electrode for exciting a plasma~~;

a radio frequency generator for supplying a radio frequency voltage to the electrode;

a radio frequency feeder connected to the electrode; and

a matching circuit having an input terminal and an output end, wherein the input terminal is connected to the radio frequency generator and the output end is connected to an end of the radio frequency feeder so as to achieve impedance matching between the plasma processing chamber and the radio frequency generator,

wherein the first series resonant frequency f_0 corresponds to a minimum impedance of the plasma processing chamber~~, the minimum impedance evaluated with the plasma chamber disconnected from the plasma apparatus during a non-discharge period~~, and

wherein at least one of the shape of ~~a~~ the radio frequency feeder ~~plate~~, ~~the~~ an overlapping area of the plasma excitation electrode and a chamber wall, a thickness of insulation material between the plasma excitation electrode and the chamber wall, ~~or~~ and ~~the~~ a capacitance between a susceptor electrode and the chamber wall is adjusted such that three times the first series resonant frequency f_0 is larger than a power frequency f_e supplied from the radio frequency generator.

86. (Currently amended) The plasma processing apparatus according to claim 85, wherein at least one of the shape of ~~a~~ the radio frequency feeder ~~plate~~, the overlapping area of the plasma excitation electrode and ~~a~~ the chamber wall, the thickness of the insulation material between the plasma excitation electrode and the

chamber wall, ~~or~~ and the capacitance between ~~a~~ the susceptor electrode and the chamber wall is adjusted such that 1.3 times the first series resonant frequency f_0 is larger than ~~a~~ the power frequency f_e.

87. (Currently amended) The plasma processing apparatus according to claim 86, wherein at least one of the shape of ~~a~~ the radio frequency feeder ~~plate~~, the overlapping area of the plasma excitation electrode and a chamber wall, the thickness of the insulation material between the plasma excitation electrode and the chamber wall, ~~or~~ and the capacitance between ~~a~~ the susceptor electrode and the chamber wall is adjusted such that the first series resonant frequency f_0 is larger than ~~a~~ the power frequency f_e.

88. (New) The plasma processing apparatus according to claim 74, wherein the electrical radio frequency factors are selected from the group consisting of: inductance and resistance of the radio frequency feeder; plasma electrode capacitance between the plasma excitation electrode and a susceptor electrode facing the plasma excitation electrode; inductance and resistance of a shaft joined to the susceptor electrode; inductance and resistance of a bellows connecting the shaft to a bottom portion of the plasma processing chamber; inductance and resistance of a chamber wall; capacitance between a gas feeding tube passing through the wall of the plasma processing chamber and the plasma excitation electrode; capacitance between the plasma excitation electrode and a chassis covering the plasma excitation electrode and the radio frequency feeder; and capacitance between the plasma excitation electrode and the chamber wall.

89. (New) The plasma processing apparatus according to claim 74, wherein a thickness of insulation material between the plasma excitation electrode and a chamber wall is adapted to set the first series resonant frequency f_0 such that three times the first series resonant frequency f_0 is larger than the power frequency f_e.